FAA-P-2627
May 2,1975

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
PURCHASE DESCRIPTION

AUTOMATED MESSAGE SWITCHING SYSTEM

1. SCOPE

1.1 Scope.- This purchase description defines the main and required characteristics for the operational performance and technical requirements of equipment to provide an automatic message switching system to replace the existing national domestic FAA Service B Data Interchange System (BDIS). This system will incorporate two identical switching facilities separately located in Government facilities and independently capable of performing the total function.

2. APPLICABLE DOCUMENTS

2.1 FAA and ICAO Documents and Other Publications.- The following specifications and standards of the issues in effect on the date of the Request For Proposals (RFP), form a part of this specification and are applicable only to the extent specified herein.

2.1.1 FAA Specifications.

FAA-D-2494/1/2	Instruction Book Manuscripts Technical; Equipment and Systems Requirements; Preparation of Manuscripts; Printing Instructions
FAA-G-2100/1	Electronic Equipment; General Requirements

2.1.2 FAA Standards

FAA-STD-013	Quality Control Program Requirements

2.1.3 International Civil Aviation Organization Manual (ICAO).

Annex 10, Volume 2, Aeronautical Telecommunications Manual.

2.1.4 FAA Order.- 7110.10C, Flight Service Handbook.

2.1.5 Other Publications.- The following Electronic Industries Association and American National Standards Institute documents of the issues in effect on the date of the Request For Proposals (RFP) form a part of this purchase description and are applicable to the extend specified herein.

EIA-STD-RS-232	Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange
ANSI X3.4	USA Standard Code for Information Interchange
ANSI X3.15	American National Standard For Bit Sequencing of the ASCII In Serial-By-Bit Data Transmission
ANSI X3.16	Character Structure and Character Parity Sense For Serial-By-Bit Data Communication in the USA Standard Code For Information Interchange
ANSI X3.24	American National Signal Quality at Interface Between Data Processing Terminal Equipment and Synchronous Data Communication Equipment for Serial Data Transmission

2.1.6 Military Standards

MIL-STD-461	Electromagnetic Interference Characteristics Requirements for Equipment
MIL-STD-781	Reliability Tests: Exponential Distribution

(Copies of this purchase description and other applicable FAA Specifications may be obtained from the Contracting Officer in the Federal Aviation Administration Office issuing the invitation for bids or request for proposals. Requests should fully identify material desired, i.e., specification, standard, amendment, drawing numbers, and dates. Requests should cite the invitation for bids, request for proposals, the contract involved or other use to be made of the requested material). (Single copies of Military handbooks and standards may be obtained from Federal Aviation Administration,

Washington, D.C. 20591. ATTN: Contracting Officer. Requests should cite the invitation for bids, request for proposals, or contract for which the material is needed. Mail requests, if found acceptable, will be forwarded to a military supply depot for filling; hence, ample time should be allowed.) (Information on obtaining copies of the Electronic Industries Association standards may be obtained from the Electronic Industries Association, 2001 Eye Street, N.W., Washington, D.C. 20006.) (Information on obtaining copies of the standards issued by the American National Standards Institute may be obtained from the American National Standards Institute, 1430 Broadway New York 10018.) (Information on obtaining copies of the ICAO documents may be obtained from Secretary General of ICAO, International Building, 1080 University Street, Montreal 101, Quebec, Canada.

3. REQUIREMENTS

3.1 General.- Hardware and software to be furnished and installed by the contractor shall be the equipment, materials, services, tests, documents, and all software programs as required to fulfill this purchase description in the quantities specified in the contract schedule. Any feature or item necessary for proper operation in accordance with the requirements of the contract shall be incorporated herein; examples are non-operational programs; assemblers, program and table loaders, disc initialization, and statistics.

3.1.1 Instruction Books.- The instruction book manuscript and instruction books to be provided shall be in accordance with FAA-D-2494/1/2 or as modified by the contract schedule.

3.1.2 Normal Test Conditions.- The normal test conditions for these automated systems shall be per FAA-G-2100/1 , Para. 1-3.2.22.

3.1.3 Service Conditions.- The service conditions shall be per FAA-2100/1 Para. 1-3.2.23 excluding 240 VAC and 48 V DC voltage. Environment I shall describe the ambient conditions.

3.1.4 Installation.- The contractor shall install, test, and prepare the system for operational use in accordance with good engineering practices. Each of the two systems shall be installed in a different location. One system shall be installed at the FAA NATCOM facility in Kansas City, Missouri, the other at the FAA Air Route Traffic Control Center in Olathe, Kansas. Each of these systems will be collocated with operational computerized equipment with humidity and temperature control as described in Para. 3.1.2, and may be subject to electrical/electronic radiation interference from installed equipment. The contractor shall accomplish all AC power and external grounding connections to FAA provided sources and provide sufficient terminating block terminals for FAA to terminate 64 four-wire data/communication circuits. The contractor shall include interface design details with his proposal.

3.1.5 Government Furnished Services.- The Federal Aviation Administration will provide AC power to the vicinity of the equipment, floor space, and provide a data cable to contractor equipment terminating block for FAA termination of leased data lines into the minicomputer system. Government furnished items and service will include AC power distribution box and circuit breakers, output AC power connection from breakers to contractor equipment via conduit or raceway, AC power receptacles, and external equipment grounding provisions. Under the floor cable entry will be provided for all connections (power and data) to the contractor's equipment.

3.2 Definitions

(a) Special Purpose - Any item available from the contractor and at the most only one source other than the contractor.

(b) Hard Copy - Teleprinter page copy.

(c) NAS - National Airspace System.

(d) Stand-Alone - Capable of performing the total basic receipt, store and forward function without support of external Government furnished components.

(e) Diagnostic Tests - Software designed to test hardware system components, assess performance, detect malfunctioning, isolate source of the problem to assembly, subassembly, or group of components, and communicate status to an indicating monitor device.

(f) MTBF - Mean-time-between-failure. The mean of the distribution of time intervals between corrective maintenance actions. It is also the reciprocal of the failure rate.

(g) MTTR - Mean-time-to-repair. The total corrective maintenance time divided by the total corrective maintenance actions during a given time period.

(h) MTBM - Mean-time-between-maintenance. The mean of the distribution of the time intervals between corrective maintenance actions. It is also the reciprocal of the failure rate.

(i) Off-the-Shelf - A fully designed, developed, and debugged computer switching system including major subsystems (Ref. Para. 3.3.1). At least two systems of this model shall be in current commercial use for at least one year with program and assembler reference manual documentation that meets the functional requirements of this purchase description with appropriate operational software design, and without hardware redesign or new development.

(j) Self-Clearing Errors - Transient disturbances, such as parity errors, which are cleared without hardware intervention or automatically by software intervention, (by use of rollback features to try the operation a second or third time), and which do not require the downgrading of the system from the current mode or level of message switching performance.

(k) Throughput - The number of useable data bits (measured in Characters Per Second (CPS), where each character is 8 bits) received by the system and placed in queue for delivery to the receiving data terminal.

(l) AFTN - Aeronautical Fixed Telecommunications Network. As used in this specification AFTN means (1) the FAA owned DS-714 message switching computer system located in Kansas City, Missouri, (2) if the paragraph reference is to messages in AFTN format the paragraph text refers to message structure.

(m) CPU - Central Processing Unit

(n) Full-Duplex (FDX) - Capable of simultaneous two-way data transfer.

(o) Half-Duplex (HDX) - Capable of two-way communication; one-way at a time.

(p) Half-Duplex Polled - Same as (o) with the provision that the control station or center polls or "calls" each location on a particular circuit to condition or make it ready to receive or transmit data.

(q) Modem - Modulator/Demodulator for data conversion and transmission over serving company leased lines.

(r) Subsystem - Major system component such as CPU, Communication Data Interface, input/output system control/monitor device (SMD), and peripheral electronic data storage (disc).

(s) Government Inspection - FAA representative will witness the contractor's testing and will carry out such visual and other inspections as deemed necessary to assure compliance with contract requirements.

(t) Continuous, unattended - The equipment shall operate without interruption in accordance with all contract requirements with no attendant present, except for periods of scheduled maintenance.

(u) Continuous - The equipment shall operate without unscheduled interruptions in accordance with all contract requirements.

(v) Failure - The inability to perform a required function within specified limits.

(w) Mini-Computer - For purposes of this purchase a mini-computer is a computer system comprised of new, latest design, solid-state components and devices (except display may utilize cathode ray tubes), small in physical size and with capacity and speed sufficient to sustain 2,000 cps throughput, as a minimum.

3.3 Detailed Requirements

3.3.1 Hardware Requirements.- The system shall comply with FAA-G-2100/1 , Part 1, Basic Requirements for all equipments, Para. 1-3.3 to 1-3.3.5; 1-3.5 to 1-3.5.2.2 and 1-3.5.11 condition B; and 1-3.6 to 1-3.7.3.1 and the system shall consist of the following subsystems and equipment.

(a) Automated message switching mini-computer with CPU. (Para. 3.3.1.1.)

(b) Input/Output system control/monitor device (SMD). (Para. 3.3.1.2.)

(c) Peripheral electronic data storage. (Para. 3.3.1.3.)

(d) Communication Data Interface. (Para. 3.3.1.4.)

(e) Test Equipment. (Para. 3.3.1.5.)

(f) Diagnostic Tests. (Para. 3.3.1.6.)

(g) All subassembly and unit interconnecting cables.

3.3.1.1 Automated Message Switching Mini-Computer System.- The system shall have sufficient central processor unit capacity and speed to sustain 2000 cps throughput (Par. 3.2(k)) as a minimum. It shall be an off-the-shelf computer switching system complete with software programs to meet the FAA NAS Air Traffic Control Subsystem operational requirements of this specification, Ref. Para. 3.3.2. It shall be capable of a data transmission rate as to accomplish those operational software requirements delineated in Paragraph 3.3.2. The system features shall include:

(a) High reliability capable of continuous, unattended operation. Ref. Para. 3.4.

(b) A system that monitors its subsystems, detects and reports failures by presenting the change in status of any subsystem to the SMD supervisory console. (Ref. Para. 3.3.2.1 (k).) The system shall also present subsystem status to the SMD upon request by an operator. (Ref. Para. 3.3.1.2.)

(c) Hardware processor memory and input/output message handling capability (Ref. Para. 3.3.1.4).

(d) The CPU shall contain a programmers control panel (PCP) by which a programmer can supply words and addresses to the program. The control panel shall have control switches that allow the programmer to start and stop the program, deposit the contents of the data switches into any register, display the contents of any register, and load programs for initial start-ups.

(e) Capable of detecting and reporting problems of communication circuits terminated to the system. (Ref. Para. 3.3.2.1 (k).)

(f) A stand-alone system. One CPU with its subsystems at one site as described in Para. 3.3.1.

(g) Overall physical size of total system including I/O, peripheral electronic data storage and interface shall be not more than four 72 inch equipment cabinets of total dimensions requiring floor space not greater than 25 square feet for actual equipment placement floor space. (Ref. Para. 3.3.1.1, 3.3.1.2, 3.3.1.3, and 3.3.1.4, concerning total system operational components.)

(h) Where required, outfitted with internal fans or blowers to cool subsystems and components adequately and to assure continuous, unattended operation.

3.3.1.2 Input/Output System Contol Monitor Device (SMD).- Each system shall include input/output devices having the following capabilities: data recording and reading (in ASCII), and a keyboard/display device. The display device shall be a cathode ray tube, or similar, having a hard copy printer capable of printing the displayed data. The SMD shall be capable of continuous duty. (Ref. Para. 4.4) to control, monitor, and display the message switching system operation and status as follows:

(a) Communicate operator commands to automatically control, configure, start, stop, and modify the parameters of the system, and indicate acceptance or rejection of issued commands.

(b) Receive system and subsystem status reports, failure reports, and present (display) them to the message switching system operator.

(c) Signalling and control capability to assign total message switching capability and responsibility to either of the two separately located identical systems. This shall be accomplished by either device connected to the common control line. Ref. Paras. 3.3.2.2.5 and 6.2.

(d) Loading of bootstrap data for automatic program loading.

(e) Loading of program patch for dynamic changes to program.

(f) These devices shall be outfitted with signal/data cabling to allow placement up to 50 feet away from the CPU.

(g) All characters transferred between the CPU and the SMD shall be displayable.

3.3.1.3 Associated Electronic Data Disc Storage.- The system shall include electronic disc storage with removable disc pack to supplement the processor memory storage facility. This storage shall be as a minimum 2.4 million 8-bit characters. Disc storage shall guarantee:

(a) Expandability to sustain throughput as specified in Para. 3.3.1.1.

(b) Allowance for any outstation to retrieve any message within three hours after message output time.

3.3.1.4 Communication Data Interface.- The mini-computer system shall be capable of interfacing with the following types of circuits:

(a) Half-duplex, 74.2 baud, asynchronous, 5 level baudot code.

(b) Half-duplex, 110. and 150. BPS, asynchronous, 8 level ASCII.

(c) Full-duplex, 74.2 baud, asynchronous, 5 level baudot code.

(d) Full-duplex, 110. and 150. BPS, asynchronous, 8 level ASCII.

(e) Full-duplex, 2400 BPS, 8 level ASCII synchronous. The mini-computer system communication circuit interface (modem) shall be capable of interfacing at 2400 BPS with the AFTN computer in accordance with EIA Standard RS-232. This interface shall utilize ASCII as described in ANSI X3.4, X3.15, and X3.16. Specific quantities of circuit types required are as contained in Para. 3.3.2.2.3 of operational software requirements.

3.3.1.5 Signal Quality and Distortion Tolerance.- The mini-computer system shall employ an internal clock for signal generation and interval timing. Distortion limits in signals transmitted and tolerance to distortion in received signals shall be as specified in Para. 3.3.1.6 for operation with a data communication equipment employing serial binary data interchange.

3.3.1.6 Telegraph Interface.

(a) Code Structure:

1) ITA-2 baudot 5 level and ASCII 8 level codes in start-stop format.

2) Stop pulse shall be selectable to 1.0, 1.42, 1.5, or 2.0 times unit length.

3) On ASCII circuits parity sense shall be selectable by strapping for odd or even operation.

(b) Telegraph/Data Signals:

1) High level, neutral, 20 milliampere, and 60 milliampere loop current between 100 and 130 Volts VDC.

2) Low level, EIA STD RS-232.

(c) Acceptable Input Distortion - 45%

(d) Output Distortion - Not to exceed 1% mark and 1% space.

(e) Each mini-computer system shall be capable of supplying the line current of item (b) 1) above for at least 10% of the low speed circuits specified in Para. 3.3.2.2.3.

3.3.1.7 Test Equipment.- The contractor shall provide a complete list of test equipment used to test, repair, adjust, etc. the system. In addition, he shall furnish all special purpose maintenance test equipment and tools designed to test, repair, adjust, operate, etc.

3.3.1.8 Diagnostic Tests.- Hardware diagnostic testing capability shall be provided as follows:

(a) On-Line Diagnostic Tests. On-line diagnostics shall be incorporated into the operational software package of each system to ensure continuous operation by testing/monitoring all major subsystems of the system and provide status upon failure and upon request. Ref. 3.3.2.1 (k).

(b) Off-Line Diagnostic Tests. Off-Line diagnostic tests for each system shall be supplied by the Contractor to test and assure the proper functioning of each subsystem and the total system and to meet the MTTR (Ref. Para. 3.4.1).

3.3.1.9 Hardware Expansion.- Hardware expansion capability (system growth) shall be at least 50% of initial procurement without reprogramming. This expansion includes the items of Para. 3.3.1 (a), (c), and (d) and shall be capable of completion in 72 consecutive hours with off-the-shelf equipment of the same design level as provided initially.

3.3.2 Operational Software Requirements.

3.3.2.1 Program.- The following are operational software program requirements for the FAA NAS Air Traffic Control Service "B" message switching mini-computer system:

(a) Simultaneous reception and storage of messages from all circuits as specified in paragraph 3.3.2.2.3. Message length shall be variable with an overall maximum length not to exceed 1600 characters.

(b) Automatic routing of single or multiple addressed messages. The system shall be capable of routing on at least 600 address indicators, including 100 broadcast indicators, and shall be either 3 or 4 characters in length. The standards of Appendix "A" of this purchase description, for the proper condition coding, which are vital in the activation and/or deactivation of equipment, shall be adhered to per message formats.

(c) Immediate queueing of messages following receipt of end of message (EOM) signal to output lines. If a transmission terminates without a proper EOM sequence a time-out of 300 to 400 msec. shall be made before transmission of messages or polling is resumed.

(d) Immediate and continuous transmission of messages in queues, in the proper order of assigned priorities, to all output lines. (See Appendix "A", page 35, Table 1.)

(e) Automatic sequential numbering and recording of both incoming and outgoing messages on all low speed half-duplex lines to assure a constant record of all traffic. Low speed full-duplex lines (Ref. Appendix "A", Format "C") shall require validation of input sequence numbers. The output sequence numbers will be appended to the message, and be recorded with the message on disc in this Service "B" system for retrieval purposes.

(f) Automatic routing back to the originator of all messages found with deficiencies detected within the message envelopes. Where the originator cannot be determined, the rejected message shall be routed for all-circuit distribution back to the circuit of origin. Rejected messages shall be preceded by an approved error statement. This applies to 74.2 baud circuits only. On the 2400 BPS circuit only the error statement (in ICAO format) shall be sent.

(g) Automatic format conversion of all Service "B" formatted (Formats A and B) messages to AFTN format (Format C) and transmission of these messages to the AFTN computer system. (Ref. Appendix A.)

(h) Automatic routing and transmission of system wide and circuit broadcast type addressed messages. The system must be capable of routing on at least 100 different broadcast indicators. Each of these indicators must be capable of making delivery to at least 65 destinations.

(i) Generation of last sent, last received sequence number reports to in-service destinations which do not show input for 60 minutes. Also generate this report to all active destinations at the close of day (2400Z).

(j) Message acquisition on Service "B" half duplex circuits by automated weighted continuous polling, that is, that some stations because of high traffic density shall be polled more than once in each polling cycle. The poll cycle for any individual circuit will not exceed 25 polls. The time-out condition between polls, when there is no response to a poll, shall be variable from 1 to 8 seconds in at least 1/2 second increments.

(k) Continuous monitoring and warning via SMD of special system conditions such as:

1) System loading (percentage of circuit queues). The system shall report on the SMD, on request, the percentage of output queues in use by the system, and automatically report the percentage of output queues in use by the system when the percentage reaches 65% and for every 5% incremental increase thereafter.

2) Circuit failures.

3) Equipment malfunctions.

4) Excessive Circuit Queues. The system shall report on the SMD, on request, number of messages on output queue by circuit, and automatically the number of messages on output queue by circuit when that number exceeds 10.

5) Systems/circuit status upon request.

(l) Provide method by which system program load time does not exceed three (3) minutes.

(m) Provide the capability for software updates and development which will not cause interference to the on-line system. These software updates shall be entered so as to change memory, circuit parameters, and program areas dynamically in the on-line system.

(n) Provide an outstation the ability to retrieve messages by input or output sequence number up to three (3) hours after message output. The outstation may specify from one (1) to ten (10) messages in one retrieval. When retrievals cannot be honored the outstation shall be notified with an appropriate reason for no retrieval.

(o) Provide the capability with an off-line service routines assembler package for program updates, and assemblies using the disc subsystem.

(p) System restart or switchovers shall not cause the loss or alteration of any messages which have been received in their entirety. Complete retransmission shall be made of all messages which were being output at the time recovery occurs. Immediately following any recovery, and before resuming transmission of other data, a notice shall be generated to each circuit notifying all destinations of the sequence numbers of their last received complete messages.

(q) Provide system control capability so that by entering commands via the SMD an operator will be able to start and stop operation of circuits and destinations. Formats shall be such so that either individual or a range of circuit or destination numbers may be specified in one command.

3.3.2.2 Circuit Configuration.- The configuration of communications circuits will be as described in paragraphs 3.3.2.2.1 through 3.3.2.2.5.

3.3.2.2.1 Low Speed Circuits.- The low speed circuits are standard teletypewriter circuits which will operate with a 74.2 unit five level baudot code at a rate of 100 words per minute. The initial complement of low-speed circuits will include full duplex, and half duplex circuits, with quantities shown in 3.3.2.2.3. The half duplex circuits will interconnect a number of stations and each station shall be capable of individually transmitting and receiving messages (serially by station).

3.3.2.2.1.1 Low Speed Circuit Control.- Control of low speed circuits shall be performed by software. There shall be software tables in memory defining parameters for each circuit connection. (Ref. Para. 3.3.2.2.3.) Accessing these tables by program shall be done in such a manner as to allow modifying or redefining the parameters of a circuit from one type to another without affecting other parameters.

3.3.2.2.1.2 Half Duplex (Low Speed).- These circuits will be those presently controlled by the BDIS System. All will be polled multipoint circuits. Polling procedures shall be the same as that now being done on Service "B" circuits by the present FAA APULS units. Ref. FAA Flight Services Handbook 7110.10C Para. 1125 . Separate input/output sequence numbers shall be assigned and maintained by the mini-computer system for each Service "B" drop on each of these circuits. This requirement shall not apply to paragraph 3.3.2.2.4.

3.3.2.2.1.3 Full Duplex (Low Speed).- These circuits will be 74.2 baud, 5 level baudot code required for the mini-computer system and AFTN system interface. The circuits will be point to point, non-polled circuits. Separate input/output sequence numbers for each of these circuits shall be maintained by the mini-computer system under program control. (Ref. Para. 3.3.2.1 (e) and 3.3.2.2.5.)

3.3.2.2.2 High Speed Circuits.- The high speed circuits shall provide a data link between the mini-computer systems and AFTN computer system. The mini-computer systems shall provide for operation of high speed lines with the following characteristics:

(a)	Signalling rate:	2400 Bits Per Second (BPS)
(b)	Code:	ASCII (Int'l version)
(c)	Transmission Mode:	SYNCHRONOUS
(d)	Control Procedures:	Shall be compatible with the AFTN high speed synchronous procedures (Appendix B)

3.3.2.2.3 Circuit Quantities.- Each mini-computer system shall be capable of serving the following circuits:

10 - 100 WPM full duplex (non-polled)

52 - 100 WPM half duplex (polled)

1 - 2400 BPS full duplex (SYNCHRONOUS)

1 - Command Control Circuit

Each system shall be capable of at least 50% circuit expansion with minimal hardware expense; that is with no additional equipment cabinets.

3.3.2.2.4 Mini-Computer Command/Control Circuitry.- A command control circuit capability, ASCII, half duplex, for command entry to the active and backup processors shall be provided for the two mini-computer systems. This circuit (non-polled) shall terminate in each SMD and each CPU to provide the capability of controlling either mini-computer with either SMD.

3.3.2.2.5 Mini/AFTN Interface Circuit.- The mini-computer systems shall interface with the AFTN computer on a 2400 BPS circuit (ref. 3.3.2.2.2) and with (2) 100 wpm circuits (ref. 3.3.2.2.1.3) as backup. The arrangement and control of these circuits shall be so that only the on-line mini-computer sends and receives messages. The backup mini shall receive only. All messages originating on any of the Service "B" low speed circuits, other than those terminated in the AFTN system, shall be transmitted over the 2400 BPS circuit by the on-line mini system.

When the 2400 BPS circuit is out-of-service the (2) 100 wpm circuits shall provide the necessary backup, however, only those messages which are routed to AFTN addresses shall be transmitted. Messages originating in the AFTN system for domestic delivery shall be received by the mini-computer system over these circuits. Message format shall be format "C". (Ref. Appendix A, Para. 1.4).

3.3.3 CPU Design Features.- Parity bit generation and checking shall be provided within the mini-computer system CPU for all data transfers involving the central processing unit memory. Fault sensing and operator signalling shall be included in mini-computer system and communicated to the SMD.

3.3.4 Systems Restart or Switchover Upon Failure.- Each separately located system (Kansas City, Missouri, and Olathe, Kansas) shall be capable of full system operational recovery. Automatic internal restarts shall be made to clear self-clearing errors (Ref. Para. 3.2. j). Capability shall be provided so that recovery from hard or non-clearing errors in the on-line system can be made in the backup system within one minute when it is signaled to assume full operational control by supervisory command entered via the SMD. (Ref. 3.3.1.2 and 3.3.2.2.5.)

3.3.5 Recovery After Power Failure.- Upon loss of primary power the system shall protect itself from damage and prevent loss or alteration of data stored in memory or hardware registers at the time of failure. When normal AC line voltage levels return the system shall resume operation without operator intervention.

3.4 Reliability/Maintainability.- The equipment as defined in this purchase description shall equal or exceed reliability and maintainability requirement using MIL-STD-781. Response to these requirements shall be: (1) Submission of a plan outlining how these requirements will be achieved (2) submission of mathematical predictions of MTBM, MTBF, and MTTR (3) a factory site reliability demonstration using MIL-STD-781, Plan XXV.

3.4.1 Minimum R&M Values.- The specified R&M values as a simplex system shall be as tabulated below:

	CPU	SMD	DISC Storage	System
MTBF	10,000 hrs.	4,000 hrs.	6,000 hrs.	2,000 hrs.
MTBM	10,000 hrs.	3,000 hrs.	3,000 hrs.	1,500 hrs.
MTTR	0.5 hrs.	1.0 hrs.	1.0 hrs.	1.0 hrs.
Service Life *	10 years	10 years	10 years	10 years

* Certification or credible statements shall be provided to certify that the service life of the system meets or exceeds the above R&M values.

3.4.2 Failure Criteria.- Failures as defined in MIL-STD-781 Para. 5.5.1.(1) "Relevant Failures" shall be applied during reliability testing and as appropriate in R&M calculations.

3.5 Radiation Frequency Interference.- The system shall not be susceptible to RFI from other electrical and electronic equipment or apparatus installed on-site nor shall the contractor's equipment be the source of radiation interference to installed FAA equipment. Where the contractor's equipment has not been tested for compliance with an interference control specification, operational performance data may be submitted similar to that obtained by RFI testing using MIL-STD-461. Alternatively the contractor shall demonstrate performance per MIL-STD-461 for computer equipment. The contractor shall correct any such discrepancies prior to FAA acceptance of the equipment.

3.6 Equipment Finish.- The equipment required under this purchase description shall have a commercial finish with a color or colors approved by the Government.

3.7 Software Documentation.- The Contractor shall provide all documentation necessary for FAA to use, maintain and modify all deliverable Service "B" computer programs. The organization of all documentation shall be complete and conform to accepted program documentation practices. Content of manuals shall be prepared and delivered in accordance with the schedule defined in the contract.

3.7.1 Operational Program Documentation.- The operational program documentation shall include a Program Description Manual and an Operator's Manual. In addition, complete listings for the computer programs shall be provided. The listings shall include appropriate comments to describe each line of code.

3.7.2 Program Description Manual.- A Program Description Manual which describes the functional requirements of all Service "B" subsystem operational programs and their relationships to the hardware and to the interfaces between other components of the system shall be provided. The manual shall include sufficient diagrams and flow charts to clearly describe how the computer programs satisfy the requirements of this specification. The manual shall provide an overview of all program routines and reference other related program documentation. The Program Description Manual shall also describe in detail the functional specifications, interfaces, flow charts, and instruction coding for each program routine described.

The Program Description Manual shall include but not be limited to the following:

(a) The manual shall specify the procedures for maintaining and updating the manual and identify the relationship of this manual to the other software documents.

(b) The manual shall provide a detailed explanation of conventions adopted within the operational program with respect to flow charting, table names, data names, routine labels and calling sequences.

(c) The manual shall provide a detailed explanation of hardware related programming factors such as input/output formats, codes, bit arrangements for control characters, communications sequences, and both normal and error interrupt processing.

(d) The manual shall provide for each subprogram within the operational program, a narrative description, specification of the program inputs, outputs and their definitions, the Service "B" subsystem functions performed, and the specific methods employed. The contractor shall provide specifications in this section showing table definitions, storage allocation and identification of reserved registers. For each subprogram, the contractor shall provide a detailed flow chart which references the general flow chart and the detailed flow charts of those subprograms within the Service "B" subsystem program which create input for it or receive output from it.

3.7.3 Operator's Manual.- An Operator's Manual which provides an operator with an understanding of the Service "B" subsystem configuration, and with all of the information needed to operate the operational programs, shall be provided. The manual shall clearly describe the relationship of the manual to other program documentation, identify procedures for updating the manual, describe the location and function of all operator controls, describe use of all data processing equipment peripherals, and provide detailed operating procedures for both normal operation and during failure modes.

3.7.4 Support Program Documentation.- The Support (non-operational) Program Documentation shall include but not be limited to an Assembler Reference Manual, an Assembler Operator's Manual, a Utility System and Program Description Manual, a Programmer's Reference Manual, and a Maintenance and Diagnostic Program and User's Manual. In addition, complete program listings shall be provided. The listings shall include appropriate comments to describe each line of code.

3.7.5 Assembler Reference Manual.- An Assembler Reference Manual which describes all actions required to prepare source language statements, initiate assembly, and analyze results as to encountered error conditions shall be provided. The reference manual shall contain sufficient detail to enable programmers to produce computer programs.

3.7.6 Assembler Operator's Manual.- An Assembler Operator's Manual which includes an assembler listing, initiation and intervention procedures, a complete list of possible error halts, and all actions required of the operator shall be provided.

3.7.7 Utility System and Program Description Manual.- Detailed documentation which includes appropriate flow diagrams and instructions to permit operation, maintenance, and program modifications for the assembler, program compilers, loaders, source tape editor, dumps, and the program debugging aids shall be provided.

3.7.8 Programmer's Reference Manual.- A Programmer's Reference Manual which includes a description of the computer instructions, commands, and orders used in an operational machine program shall be provided. The manual shall also include, but not be limited to, information on instruction timing, use of index registers, logical and arithmetic operations, data transmissions, input/output operation, use of indicator lights and branch switches, and other such programmer reference material.

3.7.9 Maintenance and Diagnostic Program and User's Manual.- Complete documentation of all maintenance programs shall be provided. This manual shall include a narrative description, listing, and definition of all program inputs and outputs for each maintenance program and specific methods used. The contractor shall supply specifications showing table definitions, storage allocation and identification of reserved registers. The manual shall also include users information such as initiation and intervention procedures, a complete list of possible operator or error halts, and all actions required of the operator or test personnel.

3.7.10 Test Program User's Manual.- The contractor shall provide a User's Manual for all deliverable test programs. The User's Manual shall include a program listing, initiation and intervention procedures, a complete list of possible operator or error halts, and all actions required of the operator or test personnel. Listings shall include appropriate comments to describe each line of code.

4. QUALITY ASSURANCE PROVISIONS

4.1 General Inspection Provisions.- The contractor shall provide and maintain a quality control program which meets the requirements specified in paragraphs of FAA-STD-013. Unless otherwise specified in the contract, all tests and inspection to determine compliance with the requirements of this purchase description shall be made by the contractor and shall be subject to Government inspection (Ref. Para. 3.2 Definitions). The Government reserves the right to waive Government inspection at the contractor's plant. If Government inspection is waived, the contractor shall furnish certified inspection records describing readings or results obtained during the inspection and tests required by the applicable contract specifications. The data must demonstrate that the equipment meets contract requirements and include the statement "This certifies that this unit fully meets all technical requirements of the contract", and be dated and signed by a responsible official of the contractor. Shipment shall not be made until the contractor receives written Government approval of the equipment inspected, or of the certified inspection records.

4.2 Acceptance Tests

4.2.1 General.- The contractor shall submit to FAA for approval four copies each of the proposed list of tests, factory test procedures, test data forms, and the on-site system hardware and software acceptance test procedures per FAA-STD-013, Para. 2.2 thru 2.3. These tests shall be submitted for approval as specified in the contract. The contractor shall perform and demonstrate the equipment tests at the factory and the on-site acceptance tests necessary to demonstrate that the systems fully meet the requirements of this purchase description.

4.2.2 Factory Acceptance Tests.- Factory acceptance tests shall be divided into three sections:

(a) Subsystem functional tests.
(b) Operational test.
(c) Reliability/Maintainability demonstration

4.2.2.1 Operational Test.- The equipment (both systems) shall be operated for a minimum period of 72 consecutive hours, meeting all specified test requirements under the test conditions specified in Para. 3.1.2. This exercise shall include a demonstration to assure that the systems are capable of certain operational/software requirements. These are: (1) circuit polling capability, (2) input/output message handling, (3) program loading, and (4) on-line and (5) off-line diagnostics. Each system shall be allowed one period of down time for maintenance not to exceed fifteen minutes during the 72 hours. The systems shall be allowed no errors during the 72 hour test. If either of the criteria are exceeded, the 72 hour test shall be restarted. Test documentation shall be maintained by the contractor per Para. 4.2.4.

4.2.2.2 Reliability/Maintainability.- The test data of Para. 4.2.1 shall include reliability/maintainability provisions. Reliability provisions shall include criteria to the subsystem level. (Ref. Para. 3.4) (Test Plan XXV, MIL-STD-781.)

4.2.3 On-site Acceptance Tests.- On-site system acceptance tests for each system shall be conducted after installation and shall consist of the FAA approved hardware and software procedures along with reliability and maintainability criteria to show compliance with all requirements. Final FAA acceptance will be made after the systems are installed at the Government sites and ready for operational use.

(a) Hardware tests. (Para. 4.2.3.1)

(b) Software/Operational tests. (Para. 4.2.3.2)

4.2.3.1 Hardware Tests.- On-site hardware tests shall be designed to assure that the system is ready to perform all software operational requirements.

4.2.3.2 Software/Operational Tests.- On-site tests shall be designed to demonstrate accurately and thoroughly system compliance with all requirements of this specification and the contract. These shall be integrated system tests to simulate actual Service "B" operation utilizing selected Service "B" circuits. In-house output displays (teleprinters) will be provided by FAA to evaluate performance and demonstrate compliance with requirements.

4.2.4 Acceptance Test Documentation.- The contractor shall record complete and accurate information during the factory and on-site tests on suitable data sheets or in log books. Test data shall include the following information:

(a) Test title.

(b) Date/time test started.

(c) Date/time test satisfactorily completed.

(d) Times test not performed (completed) satisfactorily.

(e) Maintenance record - Para. 4.3.

(f) Acceptance by FAA designated representative.

4.2.5 Test Reports.- For each acceptance test performed, the contractor shall prepare a report summarizing the test results. The report shall include pertinent data sheets according to Para. 4.2.4 above. Ten copies of the test reports shall be provided to the FAA. Test groupings shall be per Para. 4.2.3 (a) and (b).

4.3 Maintenance Records.- During factory and on-site acceptance tests, the contractor shall keep a maintenance log which lists all malfunctions, their location in the system, and how they are repaired. Odd situations such as cases in which malfunctions disappear for reasons not clearly understood, shall also be recorded. Ten copies of these reports shall be furnished to the FAA at the completion of the on-site acceptance tests.

4.4 Reliability/Maintainability.- The reliability/maintainability provisions of Para. 4.2.2.2 specify criteria to assure the agency receives low maintenance systems.

4.5 Radiation Frequency Interference.- When required by the government RFI requirements shall be specified in Para. 3.5.

4.6 Test Equipment.- The contractor shall provide test equipment for contractor-performed tests. On-site acceptance tests shall be conducted using special purpose test equipment supplied by the contractor. The contractor shall provide a list of test equipment that FAA may provide for on-site testing. Items not available on-site (FAA owned) shall be provided by the contractor for testing.

5. PREPARATION FOR DELIVERY

5.1 General.- The contractor shall be responsible for packaging, packing, marking and preservation necessities for the systems in preparation for shipment and delivery. Shipment and delivery shall be accomplished per the contract schedule.

6. NOTES

6.1 Operational Conditions - Brief Description of Existing Service B (BDIS) Operation.- The BDIS is a teletype switching system that collects and disseminates Service "B" aeronautical flight data. There are eleven BDIS centers at nine separate locations in the continental U.S. which are responsible for the polling and distribution of messages over a nation wide network of 40 low speed area "B" and supplemental "B" circuits. The area "B" circuits provide the prime means for input of instrument flight rule (IFR) flight plans to NAS computers from remote sources and also are the prime means for transfer of visual flight rule (VFR) flight plans between Flight Service Stations (FSS). Supplemental "B" circuits are provided to high activity FSS's to expedite incoming traffic. Each of the BDIS centers is on a medium speed circuit controlled by the center at Kansas City. A more detailed description of BDIS operation may be found in FAA Flight Service Handbook 7110.10, Para. 1125.

6.2 System Functional Outline Design Diagram.- Figure 1 portrays a functional outline design diagram to assist the contractor in visualizing the system. This diagram is informational only and any reliance that the contractor places on it is wholly at his own risk and shall not relieve him of his contractual obligation to comply with all requirements of this specification.

* * * * *

Figure 1, System Functional Outline, SEE PAGE 23

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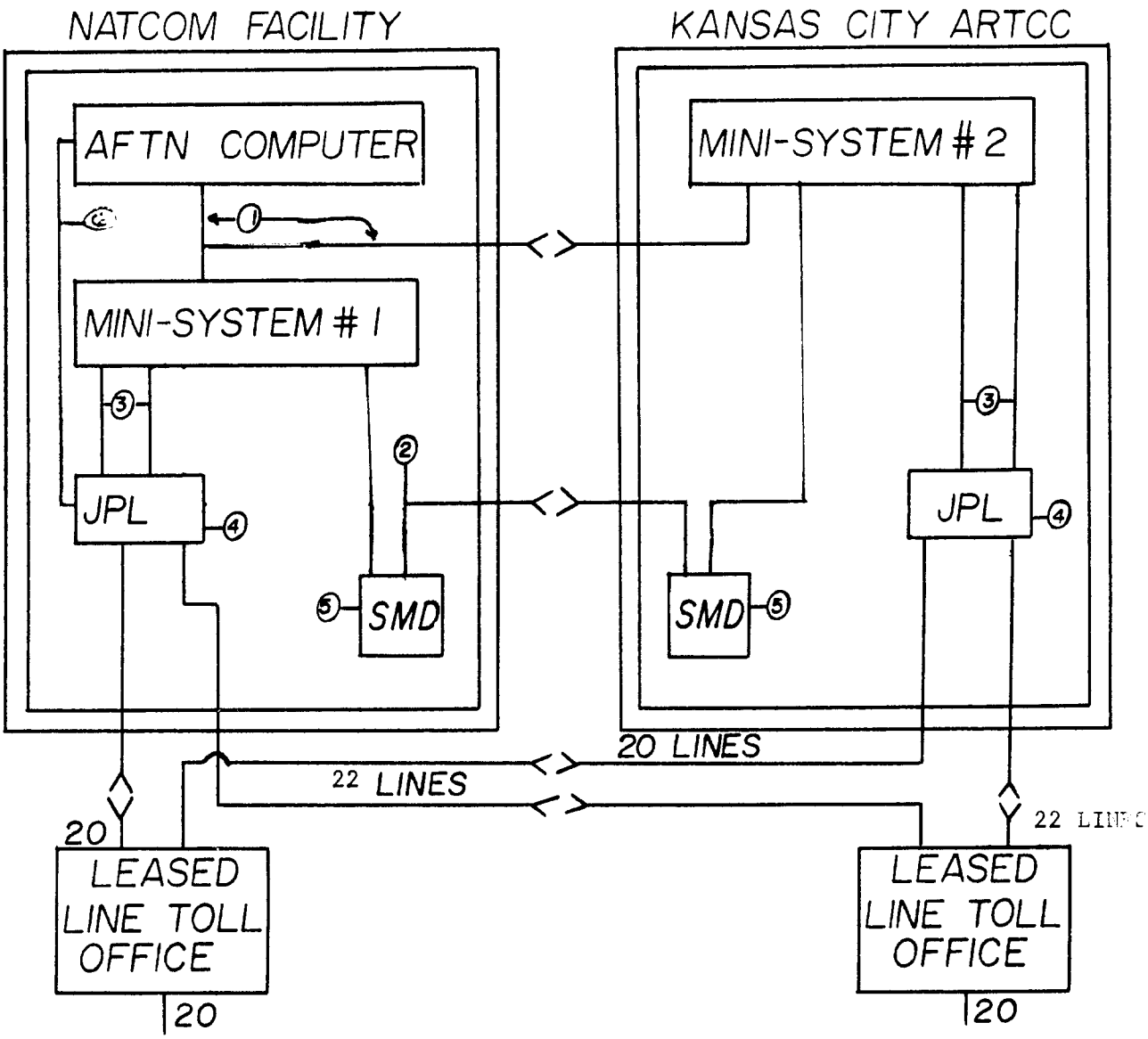

NOTE 1: Medium speed full duplex synchronous 2400 BPS circuits.

NOTE 2: Half duplex ASCII Command/Control circuit.

NOTE 3: Low speed full and half duplex circuits.

NOTE 4: FAA provided jack panels.

NOTE 5: I/O monitor/control devices for system signalling, commands, and monitoring.

NOTE 6. Low speed AFTN back-up circuits.

Figure 1

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* * * * *

APPENDIX "A"

Message Formats

1. Message Formats

1.1 Definitions

Manual Station. TSC poll (generated by Mini-computer System) ≡ < ↓ i i

ARTCC TSC poll (generated by Mini-computer System) ≡ < ↓ a a a ▫

(Where i i equals two alpha BAUDOT characters designated for the Station being polled)

(Where a a a equals three alpha BAUDOT characters designated for the Center being polled)

≡ line feed

< carriage return

↓ letters shift

↑ figures shift

→ space

▫ BAUDOT blank

<<↓ Conditioning Code

<<≡ EOL (end of line indicator)

≡≡≡≡NNNN EOM (end of message)

Priority Definitions: See Table 1, Page 35.

1.2 Format "A"

The format to be used on half-duplex polled multipoint Area "B" circuits. It consists of the (1) header line (required for intracircuit delivery only). (2) Originator Priority/Address Line. (3) Text (limit 69 characters per line, 20 lines per message). (4) EOM (End of Message) indicator, and (5) acknowledgement line (s).

Example 1: Single message transmission requiring both intra-circuit and inter-circuit relay.

≡<↓ KA (TSC Poll generated by Mini-computer System)

1) <<↓ TCL <<↓ BHM

2) <<≡ ATL → FF → MEM → TCL → PAH → BHM <<≡

3) Text

4) <<≡≡≡≡ NNNN

5a) ≡<<↓ TCL TCL 025 → 160051
<<≡≡≡≡≡≡≡≡ NNNN

5b) ≡<<↓ BHM BHM 022 → 160051
<<≡≡≡≡≡≡≡≡ NNNN

5c) ≡<<↓ ATL ATL 001 01 → 160051
<<≡≡≡≡≡≡≡≡ NNNN

NOTE: Messages represented here are expanded for easy reading only; in actual transmission there is no separation of characters except when denoted by the space symbol.

Example 2: Multi-message transmissions

≡<↓ KA (TSC poll)

<<≡ ATL → JJ → OMA → SFO → DEN <<≡

Text

<<≡≡≡≡≡≡≡≡ NNNN

<<↓ BHM

<<≡ ATL → FF → JOT → STL → BHM <<≡

Text

<<≡≡≡≡≡≡≡≡ NNNN

<<≡ ATL → GG → MKC → ZKC <<≡

Text

<<≡≡≡≡ NNNN

≡<<↓ BHM BHM → 010 → 160100
<≡≡≡≡≡≡≡≡ NNNN

≡<<↓ ATL ATL 004 → 03 → 106100
<≡≡≡≡≡≡≡≡≡ NNNN

Example 3: Messages addresses to both domestic and international locations.

≡<↓ KA (Poll)

<<≡ ATL → JJ → EHAMPA* → JFK <<≡

*Note: International address may be 6 or 8 BAUDOT characters.

Text

<<≡≡≡ NNNN

≡<<↓ ATL ATL 005 → 01 → 160105

<≡≡≡≡≡≡≡≡≡ NNNN

Example 4: Message Transmitted by the mini-computer system

<<↓ PAH <<≡

ATL → FF → MEM → TCL → PAH → BHM <<≡

Text <<≡≡≡

<<↓ PAH PAH 010 → 160052

<≡≡≡≡≡≡≡≡≡ NNNN

Line 1 is the header line made up of selection codes to enable printers at Tuscaloosa and Birmingham FSS to receive the message. Selection codes are only required for those addresses which are on the circuit of origin.

Line 2 is the address line made up of the originator's identifier, a two (2) character priority indicator, and destination address indicators. Any combination of three (3) to eight (8) character address indicators may be used.

The address line must not exceed one (1) teletype line or 69 characters total length. Messages which require delivery to destinations through the AFTN system must be prepared so that the ICAO address indicators will appear first in the address line.

Line 3 is the text and must not exceed 20 lines.

Line 4 is the end of message indicator. It shall be stripped and regenerated by the Mini-computer System after input, and during output respectively. Its prime purpose is to inhibit ARTCC 9020 PAM adaptors and suppress manual terminal devices.

Lines 5a, 5b, and 5c are the acknowledgement lines generated by the Mini-computer System, and must start with proper Station conditioning code.

Lines 5a and 5b are generated only when intra-circuit delivery is required and shows station identifiers, output sequence numbers, and current time groups for stations which are addressed on the circuit of origin.

Line 5c is made up of the originator's identifier, input sequence number of the last message received, number of messages accepted in this transmission, and current time group.

1.3 Format "B"

This format is to be used on half-duplex polled multi-point area "B" circuits for input of messages from ARTCC 9020 computers. It consists of an (1) address line, (2) text, and (3) end-of-message indicator.

Example: Message input by Atlanta ARTCC 9020 Computer.

≡<↓ ZCT ◻ (Poll)

1) <<↓ ATL <<≡

2) Text

3) <<≡≡≡≡≡≡≡≡≡NNNN

Note: This format is to be used only for the NAS 9020 Computer input to the Mini-computer System. Acknowledgement lines shall not be transmitted on the circuit for these inputs, however, a record of the messages shall be kept.

1.4 Format "C"

This format shall be used on all full-duplex circuits (Both 74.2 Baud and 2400 BPS). It is the ICAO format as shown in Aeronautical Telecommunications ANNEX 10, Volume II.

Example: ICAO Format.

ZCZC → AAA001 →→→→→→<<≡ (header line)

FF→KATLYF → KLOUYF → EGGGTF<<≡ (address line) (not required on 2400 BPS circuit)

010100 → KMKCYF<<≡ (originator line)

Text

<<≡≡≡≡≡≡≡≡≡NNNN (end of message) (not required on 2400 BPS circuit)

ZCZC = Start of message indicator

AAA = Station ID followed by three digit sequence number

→→→→→→ = optional

Rule 1 - Address indicators shall be 6 or 8 characters in length.

Rule 2 - Any address indicator received from the AFTN beginning with the letter "K" shall be routed by the Mini-computer on the 2nd, 3rd, 4th, and 5th characters. The Mini-computer shall not have routing responsibility for addresses not starting with a "K."

bility for addresses not starting with a "K".

Rule 3 - Any number of messages may be input in one transmission.

1.4.1 Format Conversion

The Mini-computer System shall convert all domestic traffic (format "A" and "B") to ICAO format (format "C") before delivery to the AFTN system. When format "A" messages are converted to the ICAO format, the following will apply:

1) No change in the priority indicator.

2) The letter "K" shall be added as the first character for all three character indicators, and replace the first character of all four character identifiers.

3) If a three character routing indicator begins with a "ZC", the 5th and 6th characters are to be a "ZQ"; if an indicator begins with "Z" and the second character is anything other than a "C", add "ZR" as the fifth and sixth characters. If the indicator is one of the nine (9) regional or headquarters office indicators, the 5th and 6th characters are to be "YA". All other indicators shall have "YF" added as the 5th and 6th characters.

4) The originator's identifier shall be converted to a 6-digit current time group followed by a 6-character originator identifier. (Ref. format "C" originator line). If the originator is a 3-character identifier, add a "K" as the first character. Rules for adding the 5th and 6th characters are the same as for para. 3 above.

When format "B" messages are converted to the ICAO format, the following shall apply:

1) A standard "FF" priority shall be used.
2) The routing address indicator shall always have a "K" inserted in front of it.
3) If the routing indicator begins with a "ZC" the 5th and 6th characters shall be "ZQ"; if an indicator begins with "Z" and the second character is anything other than a "C", add "ZR" as the fifth and sixth characters. All other indicators shall have "YF" added as the 5th and 6th characters.
4) ICAO originator line is not required for format "B" conversion.

TABLE 1. PRIORITIES OF MESSAGES

Group No./PRI	TYPES OF MESSAGES	TRANSMIT TIME	DELIVERY INSTRUCTIONS
1"SS"	Messages involving the safety of life and property. Restricted to emergency information.	Seize circuit (except Alaskan and Pacific) and transmit immediately.	Immediate delivery to all addresses. Addresses required to acknowledge.
2"DD"	Priority operational and circuit control messages.		Immediate delivery to all addresses.
"FF"	Flight movement and control messages relating to the safe and efficient operation of aircraft. Priority directive format administrative messages.	Transmit as soon possible without interrupting scan.	Immediate delivery to all addresses on circuit. Notify circuit addresses for pickup or make telephone delivery during duty hours. When office closed, notify addressee chief or duty officer of message and subject, and deliver according to local instructions.
3"GG"	TWEB Forecasts, non-urgent circuit control messages, flight cancellation and delay messages. Routine operational messages. Follow-up data relating to aircraft accident/ incident reports.	Transmit as soon as possible without interruption to higher priority traffic.	Immediate delivery to all addresses.
4"JJ"	All types not included above such as NASCOM Reports. Routine directive format administrative messages.	Transmit during the hours of 2100/0300 local time.	Immediate delivery to all addresses on circuit. Notify off-circuit addresses not later than 1030 local time on the next business day. Make delivery according to local instructions.

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APPENDIX "B"

High Speed Circuit Procedures

KANSAS CITY AFTN HIGH SPEED CIRCUIT PROCEDURES

LINE CONTROL CHARACTERISTICS

CHANNEL TYPE - Full duplex, synchronous

DATA CODE - ASCII

BLOCK SIZE - Variable 5 to 124 characters. (Includes 4 framing characters.)

ERROR CONTROLS - Character and block parity; block ACK and NACK procedures.

LINE SPEED - 2400 baud

DESCRIPTION - This synchronous line procedure requires special hardware strapping of the LCU to enable detection of the following control characters on input.

.ENQ = 005_8

.SOH = 001_8

.STX = 002_8

.ETB = 027_8

.ETX = 003_8

The first character (ENQ) is an out-of-block (i.e., not framed) character detection, while the remaining characters enable the hardware to detect the beginning and end of data transmissions.

All data transmitted on AFTN high speed channels must be preceded by three (3) synch. characters (026_8). The synch. characters are for line control and are not transmitted to the processor unless they are received by the LCU between start and end framing characters, in which case, they are ignored.

MESSAGE FORMAT

SOH/STX	N	CCC....C	CRC	RRF	DATA	ETB/ETX	BCC

SOH = Start of header (001_8)

STX = Start of text (002_8)

N = Block sequence number (Cyclic 0-9) (ASCII)

CCC...C = Priority indicator and address line. Cannot exceed priority indicator and nine addresses, or total of 69 characters. Characters included in total count are all printing and spacing characters combined. Address indicators individually must be either six or eight characters in length.

CR = Carriage return

LF = Line feed

DATA = Message text

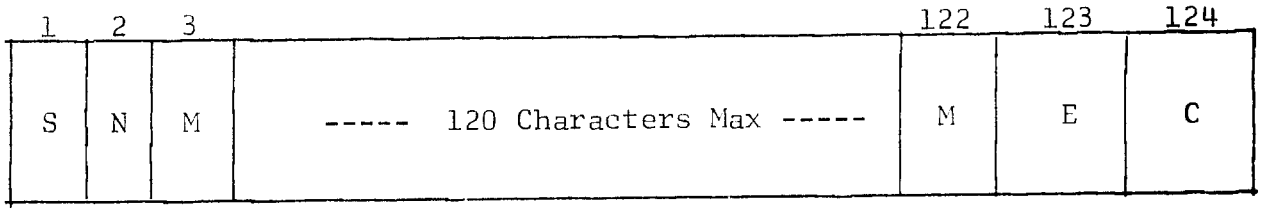
ETB = End of text block (027_8)

ETX = End of transmission (003_8)

BCC = Block check character

NAK = NACK

BLOCK FORMAT



S = Start of block character (either SOH or STX)

N = Block number character (number is cyclic and placed in each block transmitted (0-9) (ASCII).

M = Message data (Header and/or text).

E = End of block character (ETB or ETX).

C = Block check character.

START AND END FRAMING CHARACTERS (S AND E)

The "S" character for the first block is the SOH character, for all subsequent blocks the STX character is used. The "E" character for the last block of a message is ETX, for all other blocks it is the ETB character.

BLOCK NUMBER CHARACTER (N)

Block numbers 0 through 9 (ASCII) will be assigned cyclically, and will appear as the second character of the data block (immediately following the SOH or STX character).

BLOCK CHECK CHARACTER (C)

The block check character (BCC) is used to provide a block data integrity check. It is the logical sum of the N character, the M character, and the E character. The character parity bit of the BCC will be the character parity, rather than the logical sum of the other character parity bits of the block. Although the BCC is generated on output by AFTN, it is not checked on input.

GENERAL TRANSMISSION PROCEDURES

When there is no message data to be transmitted, the sender will transmit a steady mark condition on the line. (All 1's.)

At the start of transmission of data, the two interfacing systems must be synchronized. This is accomplished via the following start-up procedures.

1) Transmitting station sends:

S Y N	S Y N	S Y N	E N Q	= $(026_8 - 026_8 - 026_8 - 005_8)$

This ENQ sequence is sent at two-second intervals until two consecutive replies are received. (After first correct response is received, the next ENQ may be sent immediately.) After 60 unanswered ENQ's have been transmitted, the operator is notified of possible line or equipment trouble.

2) Receiving Station responds:

S Y N	S Y N	S Y N	S O H	N	ACK / NACK	E T X	B C C	= $(\emptyset 26_8 - \emptyset 26_8 - \emptyset\emptyset 1_8 - \emptyset -$ ASCII $\emptyset\emptyset 6_8 / \emptyset 25_8 - \emptyset\emptyset 3_8 - \emptyset\emptyset 5_8)$

All ENQ reply blocks are framed with SOH and ETX control characters. The rule which governs BCC generation for data blocks is also valid for reply blocks. The "N" field is always an ASCII zero when responding to an ENQ.

The station receiving a NACK response must withhold transmission of the next ENQ for thirty (3Ø) seconds.

NORMAL TRANSMISSION

Block numbers will be explicit and will run consecutively from Ø thru 9 (ASCII). The transmitting station need not wait for ACK before proceeding with the next block of transmission, unless/until two ACK's are outstanding, or an ETX block was transmitted. Only two unacknowledged blocks may be outstanding at any one time.

Each data block transmitted and received will be acknowledged when feasible. The acknowledgment may be a positive (ACK) (006_8) or negative (NACK) (025_8). A positive acknowledgment is sent if the following conditions are met:

1) All characters have correct parity.

2) The "S", "N", and "E", characters are proper.

3) The block sequence number is correct.

If any of the above conditions are not met, the AFTN program will either transmit a negative acknowledgment (NACK) or refuse to respond, forcing the transmitting center to rerun the block when the expected acknowledgment is overdue. When a negative response is received, the NACKed block and all blocks transmitted following the NACKed block (if any) shall be retransmitted.

DATA BLOCK ACKNOWLEDGMENT FORMAT

Acknowledgments (ACK's) and negative acknowledgments (NAK's) will carry the explicit data block numbers to which they apply.

1) ACK Format

S		A	E	B
O	3	C	T	C
H		K	X	C

2) NAK Format

S		N	E	B
O	6	A	T	C
H		K	X	C

CRITERIA FOR BLOCK REPEAT

A data block will be repeated if/when:

1) A NAK for the block is received.

2) No response for the block is received within 6 seconds after transmission. (Except for ETX block when 30 seconds will be allowed.)

3) ACK with incorrect block number is received.

4) ENQ will be repeated every 2 seconds until ACK 0 is received for two ENQ's.

RETURN TO START OF TRANSMISSION

The transmitting station will return to start of transmission procedure if during normal transmission one of the following occurs:

1) 3 NAK's (or any combination of three incorrect responses) to a given block.

2) System failure occurs at transmitting end.

After startup procedures are satisfied, transmitting station resumes data transmission with the SOH block of the message containing the block for which no response (or incorrect response) was received using block sequence number one.

When the receiving switch detects an ENQ during mid-message processing, the ENQ should be treated as a cancel request for the message in progress, in addition to returning the necessary ACK or NAK reply.

MESSAGE ACCOUNTABILITY

The ACK and NAK is on a block-accept basis. For message accountability purposes, the ACK to end-of-message block is withheld until the message is safely stored (this is why the ETX time out is set higher than the ETB time out value). Extraneous characters between blocks should be ignored.

* * * * *